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Revisiting the Twentieth Century Through the Lens of Generation X and Digital Games: A Scoping Review

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Abstract

Video games have been around since the 1960s and have impacted upon society in a myriad of different ways. The purpose of this scoping review is to identify existing literature within the domain of video games which recruited participants from the Generation X (1965–1980) cohort. Six databases were searched (ACM, CINHAL Google Scholar, PubMed, Scopus, and Web of Science) focusing on published journal papers between 1970 and 2000. Search results identified 3186 articles guided by the PRISMA Extension for Scoping Reviews (PRISMA-ScR); 4 papers were irretrievable, 138 duplicated papers were removed, leaving 3048 were assessed for eligibility and 3026 were excluded. Articles (n = 22) were included into this review, with four papers primarily published in 1997 and in 1999. Thematic analysis identified five primary themes: *purpose and objectives, respective authors' reporting, technology, ethics and environment*) and seven secondary themes: *populations, type of participants (e.g. children, students), ethical approval, study design, reimbursement, language, type of assessments*. This scoping review is distinctive because it primarily focuses on Generation X, who have experienced and grown-up with videogames, and contributes to several disciplines including: game studies, gerontology and health, and has wider implications from a societal, design and development perspective of video games.

Keywords Videogames · Games industry · Older adults · Generation X · Intergenerational · Gerontology · Ageing

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1 Introduction

Since the latter part of the Twentieth Century video games have played an integral role in the lives of citizen across society, with many developments, peaks and troughs (Forster 2005; Herman 2001; Kent 2000) throughout the decades; video games, has evolved from a niche market to a highly commercial arm of the entertainment industry. Contemporary games studies literature has grown across a diverse set of disciplines (i.e. health, gerontology, social sciences, computer science) while focusing on different populations in society (i.e. children, older adults). Yet, there has been a paucity of literature and attention focusing on the Generation X (Barnett 2017; Taylor and Gao 2014; Zickuhr 2010) from various disciplines including Gerontology, Gerontechnology and Game Studies.

The goal of this paper is to provide an overview of published studies which had recruited participants from the Generation X cohort between 1970 and 2000, and in a bid to ascertain the current landscape of game studies.

1.1 Who are Generation X?

There has been much debate concerning when the 'Generation X' (also referred to as 'Gen X') cohort starts and finishes. In this piece, we use the time frame of 1965–1980 as illustrated by (Vogels 2019)

Generation X are a cohort within society who proceed the Baby Boomers (1946 and 1964). Table 1 displays two of several perspectives of societal generations, whereby Nielsen (2014) reports how Generation X ranges between 1965 and 1976, Vogels (2019) suggests Generation X ranges between 1965 and 1980, while, Strauss and Howe have defined Generation X between 1965 and 1981 (Howe 1993; Howe and Strauss 1992; Strauss and Howe 1997).

From the stand point of the UK, the Economic and Social Research Council (ESRC) describes Generation X as "Thatcher's children: the lives of Generation X" (Economic and Social Research Council 2016). This description is apt for Generation X as they are the cohort who grew up during the premier of Margaret Thatcher

Table 1 Generation cohorts as defined by Neilsen and the Pew Research Centre

Nielsen		Pew Research Center		Age in 2016 (years)
Generation	Year	Generation	Year	
Greatest generation	1901–1924	Greatest and silent generations	1945 or earlier	71 or over
Silent generation	1925–1945			
Baby boomers	1946–1964	Baby boomers	1946–1964	52–70
Generation X	1965–1976	Generation X	1965–1980	36–51
Millennials/Gen Y				
Younger Millennials (18–27) Older Millennials (28–36)	1977–1995	Millennial	1981–1996	20–35
Generation Z	1995-Present	Post-Millennial	1997-Present	18–19

after winning a general election in 1979 and was the first British female prime minister until she left office in 1990.

From a cultural standpoint, Generation X are the first generation to experience the advent of music videos, experienced via MTV (MetLife Mature Market Institute 2013). Consequently, music/videos are now a fundamental component of a diverse range of music genres such as alternative rock, grunge, indie, hip-hop and rap.

Generation X experienced the rapid development of videogames and latterly, the movement from analogue to digital devices. The 1970s and 1980s facilitated gaming opportunities from arcade games to home consoles, using a multitude of controllers for interaction (i.e. joysticks, and buttons). Home console gaming also provided an alternative option to engage with this medium with the arrival of a second generation of consoles between the mid-1970s and the early 1990s. Moreover, the third generation integrated 8-bit units spanned between 1983 and 1995, increasing to 16-bit between 1987 and 1999 (Forster 2005; Herman 2001; Kent 2000). Throughout the 1990′s developments in hardware led to greater opportunities to engage through a wider range of formats. Arcade gaming declined as 3D games became increasingly popular through desktop and online gaming environments.

1.2 Background Literature

From an academe standpoint, Game Studies has grown over the last 30–50 years encompassing a myriad of scholarly research ranging from gender, cognition to games for health, user engagement and design. Research in this area is compounded by understanding game player experiences: immersion (Ermi and Mäyrä 2005; Marston et al. 2016; Marston 2013a; Nacke and Lindley 2008a, b, 2010), motivation, player preferences, usability (Diaz-Orueta et al. 2012; Gajadhar et al. 2010; Nap et al. 2009a, b; Fitzpatrick 2009; Harley et al. 2010; Ijsselsteijn et al. 2007); while gender in relation to videogames garnered attention to understand the game preferences, character development, the relationship between game playing as an activity and gender, online game playing engagement, gender differences between game confidence and competency (Brown et al. 1997; Hayes 2007; Jansz and Martis 2007; Jenson et al. 2007; King and Douai 2014; Temple and Lips 1989; Bryce and Rutter 2002, 2003; Jenson and De Castell 2004; Marston and Graner-Ray 2016; Cassell and Jenkins 2000; Hartmann and Klimmt 2006). Furthermore, this discipline has received interest from scholars across various disciplines who are interested in understanding videogames from a theoretical perspective and who are interested in learning the various relationships between genres and sub-genres can impact upon this discipline (Abt 1987; Adams 2009; Bogost 2007; Fencott et al. 2012; Lindley 2003; Marston and McClenaghan 2013; Mueller et al. 2008, 2011; Neale 1980; Oh and Yang 2010; Orland and Remo 2008).

1.3 Intergenerational Gaming

Up-to-date statistics surrounding older adults playing videogames (Kakulla 2020) illustrate 32% of older adults in 2019 reported to play with their spouse/partner, 29%

played with their children followed by 21% playing videogames with their grandchildren, while 19% of respondents play videogames with other additional family members and friends.

Intergenerational gaming can influence the game playing habits of older gamers, while this notion may, in some instances reduce the influence of their parent or grandparent as they themselves build their confidence. Learning about new technology and games, 10% of older adults reported to be influenced by their (grand) children in 2019, whereas in 2016 this was 17%. Learning how to play videogames, purchasing of videogames and associated technology was also lower in 2019 than in 2016, displaying 10% and 14% respectively. Additional insights and results can be found for the purchasing habits, preferences of learning and game genre preference by older adults in the scholarly work by Marston (2012); Marston et al. (2017) and Marston and Graner-Ray (2016).

Generational research in the realm of Game Studies has focused on ageing populations such as Baby Boomers. Whereas, intergenerational research has received less attention than other sub-groups of interest (Voida and Greenberg 2009, 2010, 2012). Results from (2011) highlight how intergenerational gaming was conducted by at least two generations and in some instances four. Both older and younger generations were positive in sharing their experiences during game play, whilst younger generations took leadership roles whereas, older gamers had the opportunity to practice "being more gracious experts, more patient teachers, and more thoughtful hosts and hostesses" (p. 24).

Voida and Greenberg (2012), suggest intergenerational gaming can offer researchers greater insight into designing new technologies to offer support within intergenerational gaming, noting greater motivation is offered through exploring how intergenerational gaming can offer greater affordances as well as limitations to existing game console design. Conversely, a more recent study by Wang et al. (2018) investigated the effect of videogame co-playing among family members, in a bid to understand the closeness of familial relations and satisfaction. A total of 361 parents completed an online survey, with results detailing the greater the frequency of familial gaming playing the greater the satisfaction and closeness was experienced.

In 2017, a systematic review conducted by De la Hera et al. (2017) identified 16 papers fitting the in/exclusion criteria and via data analysis identified four categories associated to the benefits of intergenerational gaming; (1) reinforcing family bond, (2) enhancing reciprocal learning, (3) increasing understanding of the other generation and finally reducing social anxiety. De la Hera et al. (2017) noted factors that informed and should be considered when considering the influences of designing videogames for intergenerational game play; (1) player-centric, motivations, resulting in wanting to play different games and the variance of abilities. Although, the second factor was game-centric, and included additional facets such as goal-oriented play and space-related forms of interactions. Which in turn play a pivotal role in understanding and identifying the key factors of designing intergenerational videogames. Several recommendations of future work to expand this area of game studies and interdisciplinary research included investigating intergenerational relationships beyond the grandparent, quantitative studies should recruit larger sample sizes, and include greater variety of videogames to offer readers further in-depth understanding

of the factors and motivations to designing games for intergenerational gaming. Through a participatory design process de Schutter and colleagues (De Schutter et al. 2017) were able to learn, understand and create six prototypes based on the experiences of five older adults and four undergraduate students. The project identified how through a four-step creative process, coupled with open, selective and theoretical coding analyses, the notion of co-creation aimed at videogame designs can be meaningful for both younger and older adults.

Given existing scholarly activity in the early part of the twenty-first century, the academe has primarily focused on older adults which has offered substantial insights into videogame playing preferences and design, as well as the benefits to engaging with video games (Brown and De Schutter 2016; De Schutter and Brown 2016; Marston and Graner-Ray 2016; Marston et al. 2012, 2013a, b, 2016, 2017; Pearce 2008). However, Generation X are a cohort of population within society that have grown up with videogames, witnessing the turbulent history of the Games Industry and the developments of many successful franchises.

The purpose of this scoping review is to identify existing literature which recruited participants categorised as Generation X between the years of 1970 and 2000. This body of work is distinctive and lends itself to a scoping review to identifying and ascertaining existing literature in a set period of time. This scoping review will identify the existing literature surrounding Generation X and aims to answer two questions, (1) *What type of research/themes were conducted that included Generation X as participants?* (2) *What impact(s) will videogames have on Generation X—the future ageing populations?*

2 Methods

2.1 Search Strategy

This scoping review was guided by the Preferred Reporting Items for Systematic Review and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) guidelines (Tricco et al. 2018). This review has not been registered but following the PRISMA-ScR checklist can be accessed via [http://www.prisma-statement.org/Extensions/ScopingReviews]. A systematic search of five electronic databases ACM, CINHAL, Google Scholar, Pubmed, Web of Science (WOS) was conducted between October and December 2018. Search strategies were adapted for each database (Table 2). Limiters were ‘English, Portuguese, Spanish’ and ‘humans’. Articles, their references (bibtex format) and where possible their CSV files, were exported into Dropbox and Mendeley.

2.2 Study Selection

The initial screening involved vetting the papers’ titles and abstracts using the inclusion and exclusion criteria described in Table 3. Where necessary the full paper was screened by the authors to determine the papers suitability. Initially, both authors

Table 2 The search criteria for each database

Database	Search	Adaptations	Results
Google Scholar	"video games" AND "gen X"	1970–2000	2000
Google Scholar	"digital games" AND "gen x"	1970–2000	1000
Pubmed	("Video Games"[Mesh] OR "video games"[All Fields] OR "computer games"[All Fields] OR "arcade games"[All Fields] OR "digital games"[All Fields]) AND ("generation x"[All Fields] OR "gen x"[All Fields])	Any filter	0
ACM	("generation x" OR "gen X" "video games" OR "digital games" OR "computer games")	Since 1970 only journals	140
Scopus	(ALL ("generation x" OR "gen X") AND ALL ("video games" OR "digital games" OR "computer games" OR "arcade games"))	(LIMIT-TO (DOCTYPE, "ar")) AND (LIMIT-TO (LANGUAGE, "English"))	45
CINAHL	("generation x" OR "gen X" "video games" OR "digital games" OR "computer games")	Published data 01/01/1970—31/12/2017 Type: clinical trial, journal article, meta-analysis, randomized controlled trial, review. Age groups: all adult. Language: English, Portuguese, Spanish	1

Table 3 Displays the inclusion and exclusion criteria

Inclusion	Exclusion
Type of document	
Articles	Editorials
Case studies	Extended abstracts or 'work in progress' papers
Report original results	Commentaries
Clinical trials	Study protocols
Randomized control trials	Book chapters
Generation X	Not finished studies
	Not available articles
	Reviews
	Ph.D., M.Sc & B.Sc thesis
	Newsletter
	Reports
	Gen Z
	Baby boomers
	Oldest old
	Millennials

separately reviewed all titles and abstracts followed by a collective decision on which papers were suitable for full review. Any discrepancies were discussed by both authors before an 'inclusion or exclusion' decision for was made.

The database search identified 3186 records. However, three records were not available from the ACM search. Similarly, three records were unavailable from the Scopus search. Following the removal of 138 duplicates, the first and second reviewers independently assessed 3048 records for inclusion. Twenty-two records met the criteria for inclusion in this scoping review (Fig. 1). Data items/variables were sought on selected papers following the criteria in Table 4. Where papers were not easily accessible, MD contacted the respective author(s) requesting a copy of the published paper via the Research Gate platform (n = 4).

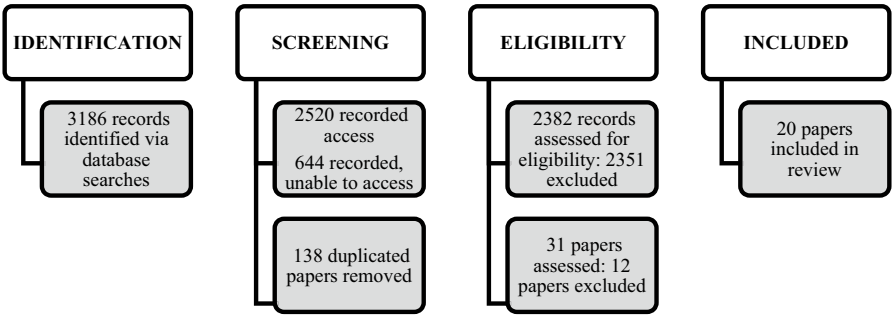

Fig. 1 Diagram showing review process

Table 4 Displays the primary, secondary themes and the total number of papers per theme

Primary themes	Secondary themes	n = papers
Purpose and objectives	Games for health	6
	Violence	3
	Cognition	4
	Gender	7
	Consumer perceptions of ratings	1
	Observation of gamers	1
	Leisure, preference, behaviour, and arousal'	5
Reporting	Sample characteristics	
	Race	5
	Age	10
	Gender	14
	Gender (men only)	4
	Gender (women only)	2
	Education	2
	Socio-economics	1
	Geographic locations	3
	Family income	1
	Type of participants	18
	University students	11
	Medical students	1
	Highschool students	5
	Health clinic	1
	Disabilities	2
	No description or held administrative positions	2
	Multiple studies or phases	6
	Study design	20
	Reimbursement	9
	Suggested future work and recommendations	16
Methods	Quantitative data	10
	Historical data	2
	Physiological data, and	7
	Qualitative data collection	2
Technology	Type of video game (commercial)	8
	Purpose built	1
	Hardware	7
	Public arcades	1
	Limited details provided	9
Ethics	Reporting ethics	5
	No ethics declared	14
	Parental consent	1

2.3 Data Analysis

Both authors reviewed the databases/papers individually and came together to jointly make the final decisions. During the review phase, the reviewers (HM and MD) discussed any concerns relating to any of the papers before making a final decision, Any discrepancies the reviewers discussed and came to an agreement, following the in/exclusion criteria.

3 Results

3.1 General Characteristics of Studies

The initial search identified 3186 abstracts published between 1970 and 2000, of which 2351 were excluded; 19 papers had full text assessment (Fig. 1). The majority of the articles were published in 1997 (n = 4) and 1999 (n = 4) with one study published in 1971. Likewise, only one study was published in the years 1980, 1983, 1985, 1986, 1988, and 1989 respectively. Two studies were published in 1994.

The sample size varied across all articles from three participants (Baer 1980) to 1600+ participants (Wilder et al. 1985). The total sample includes 4816 participants with a mean age of 24.347 ± 8.16, with a total of 1404 female participants, and 1575 male participants. Two studies did not report age or gender (Wilder et al. 1985; Philippatos and Moscato 1971), they only reported the overall number of participants recruited to their respective studies.

The majority of studies (n = 14) were conducted in the USA (Baer 1980; Ballard and Wiest 1996; Ballard and Lineberger 1999; Barnett et al. 1997; Brown et al. 1997; Calvert and Tan 1994; Funk et al. 1999, 2000; Lawton and Morrin 1999; O'Connor et al. 2000; Philippatos and Moscato 1971; Tkacz and Laforce 1998; Turner et al. 1997; Wilder et al. 1985), one study was conducted in Australia (Dalziel et al. 1989), three studies were conducted in Canada (Braun and Giroux 1989; Pepin and Dorval 1986; Miller and Ditto 1988) and two studies were performed in Europe (Kasteleijn-Nolst Trenite et al. 1999; Millett et al. 1999).

Overall study design consisted of 16 studies reporting an experimental design (Turner et al. 1997; Tkacz and Laforce 1998; Philippatos and Moscato 1971; Pepin and Dorval 1986; O'Connor et al. 2000; Millett et al. 1999; Miller and Ditto 1988; Lawton and Morrin 1999; Dalziel et al. 1989; Calvert and Tan 1994; Brown et al. 1997; Braun and Giroux 1989; Barnett et al. 1997; Ballard and Lineberger 1999; Ballard and Wiest 1996; Baer 1980), four studies reported a descriptive design (Wilder et al. 1985; Kasteleijn-Nolst Trenite et al. 1999; Funk et al. 1999, 2000).

3.2 Themes

In the following section, an extensive breakdown of the scholarly work highlighted across the primary and secondary themes. Table 5 presents an overview of the selected papers.

3.2.1 Primary Themes

A constructivist grounded theory (Charmaz 2013) approach was employed to explore potential themes from this scoping review. A total of five primary themes were identified, *purpose and objectives, reporting, methods, technology, ethics,* with corresponding secondary themes (Table 4).

Purpose and objectives theme comprised of 7 secondary themes: 'games for health', 'violence', 'cognition', 'gender', 'theory', 'ratings', and 'leisure, preference and behaviour'.

Six studies were categorised into the games for health theme (Miller and Ditto 1988; Turner et al. 1997; Kasteleijn-Nolst Trenite et al. 1999; O'Connor et al. 2000; Millett et al. 1999; Ballard and Wiest 1996). Three studies were identified in the violence theme Ballard and Wiest 1996; Ballard and Lineberger 1999; Funk et al. 2000).

Four studies were identified with a focus of cognition and spatial performance (Tkacz and Laforce 1998; Baer 1980; Braun and Giroux 1989; Pepin and Dorval 1986). Seven studies primarily focused on gender (Ballard and Wiest 1996; Braun and Giroux 1989; Brown et al. 1997; Wilder et al. 1985; Lawton and Morrin 1999; Ballard and Lineberger 1999; Funk et al. 2000). One study (Funk et al. 1999) examined consumers views relating to the ratings associated to commercial video games. One paper focused on video game responses by non-gamers who were observing (Dalziel et al. 1989). Three papers focused on video game playing preferences, experiences and habits (Barnett et al. 1997; Funk et al. 2000; Wilder et al. 1985), with an additional paper focusing on video game arousal and agressive thoughts (Calvert and Tan 1994), while one study focuses on reinforcement learning and behaviour (Dalziel et al. 1989). Finally one paper focused on players decisions within an business simulation environment (Philippatos and Moscato 1971).

Reporting theme comprised of 6 secondary themes: *sample characteristics, Type of participants, Study design, Reimbursement, Language, and Suggested future work and recommendations*. Each secondary theme is explained below.

Sample characteristics: from the standpoint of populations, five papers specifically reported the race of their respective participants (Turner et al. 1997; Barnett et al. 1997; Lawton and Morrin 1999; Ballard and Lineberger 1999; Ballard and Wiest 1996).

Ten papers reported the age of the participants (Ballard and Wiest 1996; Calvert and Tan 1994; Lawton and Morrin 1999; Pepin and Dorval 1986; Turner et al. 1997; Millett et al. 1999; O'Connor et al. 2000; Kasteleijn-Nolst Trenite et al. 1999; Baer 1980; Ballard and Lineberger 1999). Barnett et al. 1997 collected demographic data, but did not include it in their paper.

Fourteen studies reported the participants' gender (male and female) (Braun and Giroux 1989; Barnett et al. 1997; Brown et al. 1997; Calvert and Tan 1994; Lawton and Morrin 1999; Pepin and Dorval 1986; Tkacz and Laforce 1998; Turner et al. 1997; Wilder et al. 1985; Funk et al. 2000; Kasteleijn-Nolst Trenite et al. 1999; Millett et al. 1999; Dalziel et al. 1989; Funk et al. 1999). Four studies only recruited men (Ballard and Lineberger 1999; Miller and Ditto 1988; Ballard and Wiest 1996; O'Connor et al. 2000) and one study solely recruited women (Baer 1980).

Table 5 Selected papers (n = 20)

#	Reference, Title Journal Country of study	Objectives	Study design	Sample size(s), gender and age range/mean age (year)	Type of videogame/ console	Measures	Main findings
1	Baer (1980) Effect of a time-slowing suggestion on performance accuracy on a perceptual motor task Perceptual and Motor Skills USA	Examine the hypothesized relationship between a hypnotic time-slowing suggestion and performance accuracy	Experimental/control (ABABAB) study Single subject withdrawal design	N = 3 Female 100% 19,23,25 years old	Telsar Video Sports Game, model 6040 Violence not mentioned Video-tennis game (Pong), interaction with a paddle	Creative Imagination Scale (Wilson and Barber 1976)	Results show the improve of motor performance following hypnotic time-slowing, implied motivational and relaxation instructions in improving perceptual motor performance
2	Ballard and Wiest (1996) Mortal Kombat ™: The Effects of Violent Videogame Play on Males' Hostility and Cardiovascular Responding Journal of Applied Social Psychology USA	Examine the effects of videogame play	Experimental study Randomized controlled trial	N = 30 Gender = Male Age range 18–23 years (M = 19.53). Freshmen n = 16, sophomores n = 4, juniors n = 5, seniors n = 5. African American n = 1, White n = 29 $5 remuneration	Console: Sega Genesis computer videogame Videogames: the Cornet Pocket and Mortal Kombat Examine violence	Automatic electrophygmomanometer Adult sized BP cuff positioned on the non-dominant arm Questionnaire following videogame play Bell Adjustment Inventory Buss-Durkee Hostility Inventory	The level of violence varied between the 2 version of MK – MK1 resulted in less violence, whereas MK2 resulted in greater violence. Greater cardiovascular reactivity was recorded, alongside higher hostility measure scores by gamers of MK2 than MK1 Gamers of MK1 and MK2 showed increased heart rate reactivity than those playing billiards.

Table 5 (continued)

#	Reference, Title Journal Country of study	Objectives	Study design	Sample size(s), gender and age range/mean age (year)	Type of videogame/ console	Measures	Main findings
3	Ballard and Lineberger (1999) Video Game Violence and Confederate Gender: Effects on Reward and Punishment Given by College Males Sex roles USA	Examine the interactive effects of level of video game violence in gender of competitor/confederate	Experimental	N = 119 Gender = Male Mean age = 21 years White n = 96, African American n = 23	Console: Sega Genesis game system Videogame: Mortal Combat Examine violence	Study a list of 20 words Play during 15 min Draw slips of paper that would assign teacher o learner roles Test of be tested on the world pair list	This study demonstrated that violent video games affect aggressive behavior
4	Barnett et al. (1997) Late Adolescents' Experiences with and Attitudes Toward Videogames Journal of Applied Social Psychology USA	Determine whether the extent of videogame play is associated with differences in personality characteristics among videogame players has failed to yield a consistent pattern of results	Experimental	N = 229 College Students n = 127 (f: n = 56, m: n = 71) High school students n = 102 (f: n = 56, m: n = 46) White n = 82.1% M age n = 18.1 Age range 15–19 years 85.9%	Arcade videogames Nintendo Sega GameGear GameBoy	Videogame Questionnaire	Differences were found among late adolescents that were associated with their gender

Table 5 (continued)

#	Reference, Title Journal Country of study	Objectives	Study design	Sample size(s), gender and age range/mean age (year)	Type of videogame/ console	Measures	Main findings
5	Braun and Giroux (1989) Arcade Video Games: Proxemic, Cognitive and Content analyses Journal of Leisure Research Canada	Determine the psychological complexity and reinforcement characteristics of a sample of the most popular arcade videogames; sex differences; describe social structure of arcade clientele; describe certain human-to-human interaction contingencies of the games; determine the value content of the games with particular attention to violence	Experimental	N = 498 Female n = 55 Males n = 443 Not specified	18 of Montreal's largest urban video arcades More than 50 video game machines Examine violence	Observation 5 sessions	The authors suggest that arcade video games promote a competitive mentality so that, could be promote violence as well

Table 5 (continued)

#	Reference, Title Journal Country of study	Objectives	Study design	Sample size(s), gender and age range/mean age (year)	Type of videogame/ console	Measures	Main findings
6	Brown et al. (1997) Gender and Video Game Performance Sex roles USA	Investigate potential gender differences in video game (pong) performance in university students	Experimental study (three different experiments)	Experiment 1 N = 32 Male n = 16 Female n = 16 University students, received course credits as remuneration Experiment 2 N = 28 Male n = 14 Female n = 14 University students, received course credits as remuneration Experiment 3 N = 84 Male n = 42 Female n = 42 Students undergraduate courses at Pacific Lutheran University received course credit as remuneration	Experiment 1: A television ping pong game control panel Experiment 2: 34 different videogames and 12 different sports 5-point-scale 12 items from Nebes and Briggs scale	Experiment 1 One player controlling a paddle on the right side of the screen, failure to intercept the ball results in the machine scoring one point, and the game is over with a 15-points score Experiment 2 Analysis by gender, order, hand used, trial, with repeated measures on the last two factors Experiment 3 The game is over with a 10-points-score	Results identified both genders performed badly when playing Pong with female audiences, whilst male participants played better than females in Experiments 1 and 2. Across all Experiments participants of both genders demonstrated significant improvement in their performance.

Table 5 (continued)

#	Reference, Title Journal Country of study	Objectives	Study design	Sample size(s), gender and age range/mean age (year)	Type of videogame/ console	Measures	Main findings
7	Calvert and Tan (1994) Impact of Virtual Reality on Young Adults' Physiological Arousal and Aggressive Thoughts: Interaction Versus Observation Journal of Applied Developmental Psychology USA	Compare the impact of playing versus observing a violent virtual reality game on young adults' arousal levels, feelings of hostility and aggressive thoughts	Experimental	N = 36 (M age = 20 years, 6 months) Female n = 18 Male n = 18 Middle class college students	Virtual reality games	Pre-test: Personality trait measure (Buss and Durkee 1957) Post-test: pulse rate, Multiple Affective Adjective Check List & thought-listing questionnaire	Results suggest that participants may not generalize these actions to real life situations
8	Dalziel et al. (1989) Behavioural Correlates of Extrinsically Reinforced Video Game Play Behavioral Processes Australia	Investigate to identify intrinsic and extrinsic reinforcement video game	Experimental	Experiment 1 and 2 (same population) N = 10 Male n = 5 Female n = 5 First and second year students	TV Screen and video game unit	Observation	The data obtain suggest that human conception of ERCB may be experimentally identified and manipulated. This has important implications for the more subtle effects of reinforcement over and above commonly measured target response changes

Table 5 (continued)

#	Reference, Title Journal Country of study	Objectives	Study design	Sample size(s), gender and age range/mean age (year)	Type of videogame/ console	Measures	Main findings
9	Funk et al. (1999) Rating Electronic Games, Violence Is in the Eye of the Beholder Youth & Society USA	Compare commercial ratings for popular electronic games with consumer perceptions	Descriptive	Sixth graders n = 52 (Female n = 38); Parents n = 37 (Female n = 31), Non-parents n = 146 (Female n = 93)	Games: Doom; Mortal Kombat; Street Fighter; Sonic; Pacman; Donkey Kong; Mario Brothers & Aladdin Game	Categorize each of the 49 listed games that they had played or had observed someone play	This study was limited to perceptions of violent content. The list of games generated by the fourth graders did not permit comparison of consumer perceptions with the content-based system
10	Funk, et al. (2000) Preference for Violent Electronic Games, Self-Concept, and Gender Difference in Young Children	Examined the relationships between participants and videogames based on gender, time commitment, preference for violent games and self-concept	Descriptive	Fourth and fifth grade students (n = 364; females n = 203; males n = 160) 1 student did not respond). Midwestern suburban school district	N/A	Measures: The Harter Self-Perception (1985). "[…] consists of six subscales-scholastic competence, social acceptance, athletic competence, physical appearance, behavioral conduct, and global self-worth (selfesteem)-each of which contains six statements with two options"	This study identified via completed survey that participants showed stronger preferences towards violent videogames—and was associated to lower self-perceived behavior. Boys more so than girls listed greater preference (favourite video game) as violent games and girls spend less time playing than boys

Table 5 (continued)

#	Reference, Title Journal Country of study	Objectives	Study design	Sample size(s), gender and age range/mean age (year)	Type of videogame/ console	Measures	Main findings
11	Kasteleijn-Nolst Trenite et al. (1999) Video-Game Epilepsy: A Euroepan Study Epilepsia Portugal, Italy, UK	Investigate if video games could be a provocative factor of seizures	Descriptive	N = 387 Split between 3 age groups (13–18 years, 19–30 years, > 30 years) –no exact numbers presented. Only in Figure 2. Female n = 220 Male n = 167 UK Participants (male n = 24; female n = 11)	Super Mario World Nintendo	Electroencephalogram (EEG) examination, intermittent photic, pattern, and television simulation	Of the patients who were referred because of seizures, in front of the television or evoked, by a video or computer game, 14% proved not to be photosensitive. There were no differences between age or use of medication

Table 5 (continued)

#	Reference, Title Journal Country of study	Objectives	Study design	Sample size(s), gender and age range/mean age (year)	Type of videogame/ console	Measures	Main findings
12	Lawton and Morrin (1999) Gender Differences in Pointing Accuracy in Computer-Simulated 3D Mazes Sex Roles USA	Examine factors that might affect the gender difference in pointing accuracy using three-dimensional computer simulated mazes	Experimental	Experiment 1 Female n = 123, Male n = 96 Mean age = 22.68 (SD = 6.36) White n = 92%; African American n = 4%; Asian American n = 3% Experiment 2 (n = 182) Female n = 115, Male n = 67, Mean age = 22.60 (SD = 6.92), White n = 82%; African American n = 7%; Asian American n = 5%; Hispanic n = 4%	Experiment 1: play mazes created using DoomCad—Doom II Experiment 2: decision what way should a video snake turn	Experiment 1: mazes about one turn, two turns, four turns or six turns Experiment 2: mazes like experiment 1 and a 5 point scale about past video game experience	Results from these 2 experiments display differences between genders associated to the accuracy of pointing in a simulated environment. Women more than men showed a 20° pointing error. Further exposure is necessary to determine whether women and men would eventually reach similar asymptotic levels of performance

Table 5 (continued)

#	Reference, Title Journal Country of study	Objectives	Study design	Sample size(s), gender and age range/mean age (year)	Type of videogame/ console	Measures	Main findings
13	Miller and Ditto (1988) Cardiovascular Responses to an Extended Aversive Video Game Task Psychophysiology Canada	Examine the cardiovascular effects of long-term active stressors by exposing human subjects to a one-hour shock avoidance procedure	Experimental	n = 10 Gender = Males Renumeration $5/hour	Atari video games: hockey, maze craze, tennis, enduro	Systolic, diastolic and mean arterial blood pressure Heart rate Digital blood volume pulse (DBVP) Respiration rate Two experimental sessions	The results indicated that individual differences in mean arterial blood pressure response to the stressor were significantly related to individual differences in heart rate response to the first 15 min, but increasingly unrelated to heart rate response, and more related to DBVP response, as the session progressed

Table 5 (continued)

#	Reference, Title Journal Country of study	Objectives	Study design	Sample size(s), gender and age range/mean age (year)	Type of videogame/ console	Measures	Main findings
14	Millett et al. (1999) Seizures During Video-Game Play and Other Common Leisure Pursuits in Known Epilepsy Patients Without Visual Sensitivity Epilepsia UK	Examine systematically whether exposure to video game material is a risk factor for seizures in patients with chronic epilepsy without visual sensitivity	Experimental	N = 212 Female n = 100 (47%) Male n = 112 (53%) Median 31 years Range 16–57 years	Sega 16X: The lion king, Football 95, Racing, Sonic and Knuckles, Sylvester and Tweety Super nintendo: Wild and Wacky Sports, Tazmania, Donkey Kong Country, The Jungle Book, Earthworm Jim Sega Saturn System: Pebble Beach Golf, Rally Racing, Virtuo 16Cop, Pinball, Bug, Clockwork Knight	Video game playing session or a period of leisure (i.e. reading, physical exercise, puzzles…) Video EEG monitoring	The authors do not identify a greater risk factor of seizures in patients with epilepsy during video game play compared with other common leisure pursuits

Table 5 (continued)

#	Reference, Title Journal Country of study	Objectives	Study design	Sample size(s), gender and age range/mean age (year)	Type of videogame/ console	Measures	Main findings
15	O'Connor et al. (2000) Evaluation of a Manual Wheelchair Interface to Computer Games Neurorehabilitation and Neural Repair USA	Phase 1: the purpose was to have wheelchair athletes evaluate the wheelchair-computer game interface and identify the type of game that the subjects preferred to play with the system Phase 2: was to identify whether the GAME wheels could elicit and exercise training response	Experimental	Phase 1 N = 35 Mean age = 42.2 (SD = 13.9) Gender: Male Mean Years post SCI (9 cervical, 14 thoracic, 5 lumbar, and 7 other types of disabilities) including amputations and nerve disease 17.0 ± 11.6 Phase 2 N = 10 3/10 females Mean age = 41.9	GAME wheels Video games: need for speed II, the ultimate doom and power boat racer	Phase 1 Verbal description of the operation of GAME wheels system and the computer games Phase 2 Physiologic data were collected	GAME wheels could be a adequate system to exercise. Further investigation is necessary to demonstrate the effectiveness

Table 5 (continued)

#	Reference, Title Journal Country of study	Objectives	Study design	Sample size(s), gender and age range/mean age (year)	Type of videogame/ console	Measures	Main findings
16	Pepin and Dorval (1986) Effect of Playing a Video Game on Adults' and Adolescents' Spatial Visualization Paper presented at the 1986 Conference Paper: AERA Annual Meeting, San Francisco Canada	Assess the effects of the practice of a video game on spatial visualization test scores	Experimental	Experiment 1 (n = 70): Females n = 33, Males n = 37 Mean age = 22 Experiment 2 (n = 101): Females n = 60, Males, 41 males Mean age = 13	Video Game Zaxxon	Experiment 1: Space Relations Test of the DAT Experiment 2: survey and Space Relations Test of the DAT	It remains difficult to take a firm position concerning the effects of video game practice on spatial visualization
17	Philippatos and Moscato (1971) Effects of Constrained Information on Player Decisions in Experimental Business Simulation: Some Empirical Evidence Journal of the Association for Computing Machinery USA	Test whether in game playing the decisions made by temporarily formed groups with lack of information about the name, nature, and rules of the simulation	Experimental	N = 200 Age & Gender not specified	Video games: FINANSIM, MARKSIM	Variables analyzed with FINANSIM: production, plant capacity and machine capacity Variables analyzed with MARKSIM: price, quality and national advertising expenditures Divided in two groups: informed and uninformed	There no exist significant differences in the decisions of the groups that were separated into informed and uninformed in two different business simulations of serious complexity that were augment marketing and financial skills

Table 5 (continued)

#	Reference, Title Journal Country of study	Objectives	Study design	Sample size(s), gender and age range/mean age (year)	Type of videogame/ console	Measures	Main findings
18	Tkacz and Laforce (1998) Sex of Player and Practice in Lateral Discrimination and Videogame Performance Perceptual and motor skills USA	Extend those findings to dynamic spatial performance involving navigation in a videogame by investigation acquisition of skill and predictors of performance for men and women	Experimental	N = 21 Students Females n = 13, Males n = 8	Video game Snakebyte	Questionnaire regarding anxiety about performance of spatial tasks. Three timed papers and pencil tests of directional information processing	Game performance was related to both scores on spatial anxiety and right-left discrimination. Skill acquisition curves did not differ for the 8 men and 13 women.
19	Turner et al. (1997) Use of virtual reality car-driving stressor in cardiovascular reactivity research Behavior Research Methods, Instruments and Computers USA	Provide an evaluation of the possible merits of utilizing a commercially available virtual reality car-driving task in cardiovascular reactivity research	Experimental	N = 18 Males n = 11, Females n = 7 Mean age = 24.2 (SD = 1.5) White n = 6; African American n = 1 $10 remuneration per participants, additional $25 for the fastest male and female drivers (males), 24.9 (females)	Panasonic Real 3DO Interactive Multi-Player Kaiser Electro Optics Vision Immersion headset Need for Speed	Electrodes and blood pressure 10 min car driving simulation task	The evidence provided here strongly suggests that this virtual reality car-driving simulation stressor may be a useful addition to risk identification protocols

Table 5 (continued)

#	Reference, Title Journal Country of study	Objectives	Study design	Sample size(s), gender and age range/mean age (year)	Type of videogame/ console	Measures	Main findings
20	Wilder et al. (1985) Gender and Computers: Two Surveys of Computer-Related Attitudes Sex roles USA	Provide data concerning the extent to which perceptions of and attitudes toward computers and video games differ between sexes of school age	Descriptive	N = 1600 From kindergarten to grade 12	Video games and computer	Demographic data, out-of-school activities, favorite school subjects, access to and use of computers and video games at home	The differences between the sexes in attitudes toward the computer are statistically significant but quite small in an absolute sense.

Three studies reported the geographic locations (e.g. urban/city/metro) (Funk et al. 2000; Calvert and Tan 1994; Barnett et al. 1997), where the participants were recruited. Three studies reported additional demographic data such as paricipants social class (e.g. lower/middle or upper class), Ballard and Lineberger (1999); Pepin and Dorval 1986; Funk et al. (1999), and one study reported family income (Barnett et al. 1997).

'Type of participants' were identified 11 studies who recruited University/college students (Dalziel et al. 1989; Ballard and Lineberger 1999; Ballard and Wiest 1996; Barnett et al. 1997; Lawton and Morrin 1999; Miller and Ditto 1988; Pepin and Dorval 1986; Tkacz and Laforce 1998; Philippatos and Moscato 1971; Brown et al. 1997; Calvert and Tan 1994). One study recruited medical students (Turner et al. 1997), four studies recruited younger participants from middle and high school (Barnett et al. 1997; Wilder et al. 1985; Funk et al. 1999), while in a later study recruited 4th and 5th grade students as participants (Funk et al. 2000). Only one study recruited participants from an epilepsy clinic (Kasteleijn-Nolst Trenite et al. 1999), Millett et al. (1999) recruited participants who had been diagnosed with epilepsy and one study did not describe the participants (Braun and Giroux 1989). Baer (1980) recruited participants (n = 3) who held positions as secretaries (n = 2) and a third participant was a teacher. O'Connor et al. (2000) recruited several participants for Phase 1 of their study who had various spinal cord injuries (SCI) including, cervical, thoracic, lumbar, while several participants had various disabilities including amputations and nerve disease. Furthermore, Phase 2 of the study, included two participants with additional health conditions such as multiple sclerosis and spinal cord disease respectively. One study (Wilder et al. 1985) noted they had collected demographic data but did not report it in this respective publication.

Multiple studies were reported in five pieces of respective scholarly research (Miller and Ditto 1988; Dalziel et al. 1989; Pepin and Dorval 1986; Brown et al. 1997; Lawton and Morrin 1999; with one study noting mutliple phases (O'Connor et al. 2000).

Study design identified 16 studies reporting an experimental study design (Baer 1980; Ballard and Lineberger 1999; Ballard and Wiest 1996; Barnett et al. 1997; Turner et al. 1997; Pepin and Dorval 1986; Philippatos and Moscato 1971; Tkacz and Laforce 1998; Brown et al. 1997; Calvert and Tan 1994; Dalziel et al. 1989; Lawton and Morrin 1999; Miller and Ditto 1988; O'Connor et al. 2000; Brown et al. 1997; Millett et al. 1999). Four studies reported a descriptive study design (Funk et al. 1999; 2000; Kasteleijn-Nolst Trenite et al. 1999; Wilder et al. 1985), with one study being an multi-centered site (Kasteleijn-Nolst Trenite et al. 1999) across Europe.

Reimbursement was offered to particiapnts in the various studies. Five studies offered participants either course credit/percentage of their final grade (Philippatos and Moscato 1971; Tkacz and Laforce 1998; Barnett et al. 1997; Brown et al. 1997; Ballard and Wiest 1996), and three studies offered a monetary reimbursement to participants (Miller and Ditto 1988; Turner et al. 1997; Dalziel et al. 1989). Ballard and Wiest (1996) offered a monetary reimbursement to their participants for a follow-up.

Future work and recommendations: were discussed in 15 studies (Baer 1980; Ballard and Lineberger 1999; Ballard and Wiest 1996; Barnett et al. 1997; Brown et al. 1997; Lawton and Morrin 1999; Pepin and Dorval 1986; Philippatos and Moscato 1971; Tkacz and Laforce 1998; Funk et al. 1999; Kasteleijn-Nolst Trenite et al. 1999; Turner et al. 1997; Wilder et al. 1985; Funk et al. 2000; O'Connor et al. 2000). Four studies (Braun and Giroux 1989; Dalziel et al. 1989; Calvert and Tan 1994; Millett et al. 1999) did not report any future work or recommendations. However, one study noted how their respective work and results could impact policy makers and stakeholders (Calvert and Tan 1994).

Methods is a primary theme and comprises of several secondary themes: *quantitative data collection, historical data*, *physiological data*, and *qualitative data collection*. Across all studies a myriad of measures and assessments were used and deployed. *Quantitative data* collection includes 10 studies (Baer 1980; Barnett et al. 1997; Tkacz and Laforce 1998; Ballard and Wiest 1996; Lawton and Morrin 1999; Funk et al. 2000; Ballard and Lineberger 1999; Pepin and Dorval 1986; Braun and Giroux 1989; Wilder et al. 1985) using either existing, validated measures or/and assessments tools, or as Philippatos and Moscato (1971), utilized the game calculations.

Historical health data was collected from two studies (Millett et al. 1999; Kasteleijn-Nolst Trenite et al. 1999) relating to participants experiences of sunlight, artificial light (e.g. nightclub), or pattern-evoked seizures. Participants were asked about seizures relating to their television use, type of program, viewing distance, artificial light, medication use.

Physiological data was collected across seven studies (Turner et al. 1997; O'Connor et al. 2000; Millett et al. 1999; Miller and Ditto 1988; Kasteleijn-Nolst Trenite et al. 1999; Ballard and Wiest 1996; Calvert and Tan 1994). The type of physiological data collected varied depending upon the respective study and included hemodynamic monitoring (e.g. systolic blood pressure, diastolic blood pressure, cardiac output, and peripheral resistance), heart rate, video EEG, and blood pressure. Miller and Ditto (1988) subjected their participants to electric shocks based on their video game performance. For example, "Video game play was translated into a shock avoidance procedure by the requirement of certain levels of performance to avoid shocks. […] At the beginning of each trial, the subject was informed of the score necessary to avoid the possibility of receiving a mild electric shock" (Miller and Ditto 1988, p. 202).

Qualitative data collection was collected in two studies (Dalziel et al. 1989; Funk et al. 1999) and included interviews with children about their computer/game experience both inside and outside of the classroom; to understand content perception of videogames by asking participants to categorize the 49 listed videogames. Verbal data was collected via participant observations across three experiments, relating to extrinsic reinforcement, correlating to behaviour.

Technology is the five primary theme and comprised of three sub-themes: *type of video game (i.e. commercial), purpose-built, hardware, public arcades and limited details provided.*

Eight studies reported the use of commercial video games such as Super Mario Bros and Super Mario World (Kasteleijn-Nolst Trenite et al. 1999), Zaxxon

(Pepin and Dorval 1986), Pong (Baer 1980; Brown et al. 1997), Mortal Kombat (Ballard and Wiest 1996), Corner Pocket (Ballard and Wiest 1996), Mortal Kombat I, II, and NBA Jam (Ballard and Lineberger 1999), The Ultimate Doom, Power Boat Racer and the Need for Speed II (O'Connor et al. 2000) and Doom II (Lawton and Morrin 1999). Miller and Ditto (1988) used five different video games (hockey, maze craze, tennis accessible on the Atari games console. Snakebyte was used by Tkacz and LaForce (1998); while Millett et al. (1999) used various games depending on the videogame console and included, The Lion King, Football'95, Racing, Sonic and Knuckles, Sylvester and Tweety, Pebble Beach Golf, Rally Racing, Virtu0 Cop, Pinball, Bug, Clockwork Knight, Wild and Wacky Sports, Tazmania, Donkey Kong Country, The Jungle Book, Earthworm Jim. Funk et al. (1999), used several commercial games including: Doom, Street Fighter, Sonic, Pacman, Donkey Kong, Mario Brothers, Mortal Kombat and Aladdin in their study. One study focused on video game arcades (Braun and Giroux 1989) and three studies reported purpose-built videogames (Philippatos and Moscato 1971; Calvert and Tan 1994; O'Connor et al. 2000) used the virtual reality game Dactyl Nightmare and included additional gaming peripherals (e.g. goggles, a belt to control the direction of movement, and a pistol-action device) to control the perception of body movement. Turner et al. (1997) used the videogame "Need for Speed". Space Invaders was used in the study by Dalziel et al. (1989).

A second sub-theme *hardware* identified seven papers which used commercial hardware (Baer 1980; Ballard and Lineberger 1999; Ballard and Wiest 1996; Brown et al. 1997; Millett et al. 1999; Turner et al. 1997; Dalziel et al. 1989. One study used purpose-built hardware (O'Connor et al. 2000) while, Braun and Giroux (1989) investigated several public video game arcades. Nine studies reported no specific video game hardware (Pepin and Dorval 1986; Tkacz and Laforce 1998; Calvert and Tan 1994; Kasteleijn-Nolst Trenite et al. 1999; Lawton and Morrin 1999; Funk et al. 1999; Miller and Ditto 1988; Philippatos and Moscato 1971; Wilder et al. 1985) which provided little information surrounding respective technology. One study (Funk et al. 2000) did not use any hardware.

Ethics was the fifth primary theme, and five studies (Ballard and Wiest 1996; Ballard and Lineberger 1999; O'Connor et al. 2000; Millett et al. 1999; Turner et al. 1997) reported informed consent/ethical approval, with an additional study reporting they had collected parental consent (Barnett et al. 1997). A total of 14 studies did not report informed consent by participants or ethical clearance from their institution (Brown et al. 1997; Baer 1980; Calvert and Tan 1994; Funk et al. 1999; Funk et al. 2000; Kasteleijn-Nolst Trenite et al. 1999; Lawton and Morrin 1999; Miller and Ditto 1988; Tkacz and LaForce 1998; Dalziel et al. 1989; Pepin and Dorval 1986; Braun and Giroux 1989; Wilder et al. 1985; Philippatos and Moscato 1971.

4 Discussion and Conclusions

This scholarly body of work identifies and narrates the existing evidence surrounding videogames and the Generation X cohort (1965–1980). This scoping review aimed to answer two research questions, (1) *What evidence is there of contemporary work that includes Generation X as participants?* and (2) *Based on existing evidence, what impact(s) will this evidence have on Generation X—the future ageing populations?*

Firstly, this distinctive scoping review has identified 20 peer reviewed journal papers published between 1970 and 2000 based on the inclusion and exclusion criteria. Analysis of the selected papers using a constructivist grounded theory approach and revealed five primary themes, with corresponding secondary themes.

This distinctive piece of scholarly work has captured a point in twentieth century history surrounding the field of Game Studies, which has continued to grow and expand into the twenty-first century. The selected papers identified various themes, which formed the first primary theme—*purpose*, with the majority of papers focusing on gender (n = 5). While seven secondary themes were highlighted under the primary theme—*reporting* which identified future work/recommendations (n = 17), gender (n = 12), study design (n = 16), type of participants (n = 18) and sample characteristics (n = 20) been noted across the various 20 selected papers.

Twelve papers did report findings based on mixed gender, whereas a further six papers, reported results for a specific gender—men more so than women and a further two papers did not specify a specific gender during their reporting. This could be due to the period in time, whereby videogames were perceived as an entertainment medium for men more than women.

Over half of the selected papers, offered readers an insight into future work and proposed recommendations (n = 17), although four papers did not include this information. The majority of papers conducted quantitative data collection (n = 6), followed by physiological data (n = 6) and qualitative data (4). Eight papers reported using commercial hardware where as two papers reported to use purpose-built console, while 11 papers provided limited details about the type of technology used in their respective research.

Finally, 14 papers did not report to have received ethical clearance from their institution and this included asking respective participants for their informed consent and only one paper did report parental consent was needed for the respective children to take part in the study. As noted in the results section, one paper (Miller and Ditto 1988) exposed participants to electric shocks, and for taking part in this study participants received a monetary reimbursement. However, this selected paper is one out of 14 papers that did not report ethical clearance/informed cosent. Given the respective study design (e.g. electric shocking) it can be assumed that ethical clearance was applied for and granted by the institutional research ethics committee. Furthermore, the same assumption can be made for the additional 13 selected papers which did not declare their respective ethical clearance, but still had their

results published. Overall, a total of five papers reported to have received ethical approval from their respective institution/collected informed consent from respective participants.

This body of work is of historical importance from the standpoint of games studies, social sciences and interdisciplinary research because of the varied type of research conducted during this period of time. Additionally, research boundaries have been pushed which has led to great advancements in the field of Game Studies, and interdisciplinary research, resulting in character design and development, user engagement, games for health, usability and accessibility, all of which have facilitated research advancements into the twenty-first century.

Our second research question: *Based on existing evidence, what impact(s) will this evidence have on Generation X—the future ageing populations?* Is answered based on the probable impact on the Generation X cohort, and their initial engagement and exposure to videogames and their decisions to play different genres during their lives.

The existing evidence presented here, illustrates how many of the participants at the time of the respective studies been conducted, were either children, teenagers or young adults. Thus, their initial experiences and exposure to videogames may have impacted greatly on their current and future playing habits, in particular transitioning into later life and when they started to have children and grandchildren. Participants experiences may impact on, and transfer onto the perceptions and attitudes of their children and grandchildren. Furthermore, there is the possibility intergenerational opinions are also framed based on their parents or grandparents game playing experiences and habits. For example, if a Gen Xer is playing a game, and their child or grandchild are watching or even playing with them, this knowledge and narrative surrounding why this Gen Xer is playing this particular game or genre will be shared. Similarly, for contemporary gamers categorised in the Generation X cohort, the gamers who may have previously preferred traditional game-playing engagements such as game pads or keyboards, whereas now due to phenomenal technology developments have adapted to using gesture, motion and voice recognition.

Limitations of this scholarly work include the possibility of missing key pieces of research which may not have been identified through the database searches.

Future work should consider conducting a series of participatory design workshops (De Schutter 2011; De Schutter and Vanden Abeele 2010; Marston 2012; Pearce 2008), enabling in-depth and insightful knowledge exchange and discussion surrounding the barriers, enablers, needs and requirements of engaging, designing and developing videogames for and by Generation X.

To date, little work has focused on videogames and the Generation X (Brown and Marston 2018) cohort. Yet, Generation X will be the next ageing cohort in society; and their technology and videogame experiences vary significantly to their predecessors—the Baby Boomers. Thus, the academe cannot and should not expect to transfer, coherently the lessons learned from existing research relating to Baby Boomers and their engagement and preferences of videogames, because there are significant differences between the two cohorts.

To prepare for an ageing Generation X population and proceeding generations (e.g. Millennials, and Generation Z), who are tech savvy, and have grown-up with

videogames, research has to start now. A recommendation proposed earlier, suggested participatory design workshops should be conducted to establish initial insights and baseline data. Scholars who have previously conducted similar research relating to Baby Boomers, can certainly learn from and transfer the pitfalls previously encountered. This piece of work is crucial in the context of inter-and-cross disciplinary research, and for those respective disciplines, scholars, industry partners, health practitioners and policy makers who take an interest in age-related activities, policy and research.

Such workshops, and interdisciplinary research extends into the Age-friendly narrative. From a global standpoint since 2007, there has been guidance set out by the World Health Organization (WHO) offering cities and communities an 8-point framework (WHO 2007) to develop respective environments into an age-friendly city or community. Based on this proposed extension by Marston and van Hoof (2019), videogames can be integrated into this respective framework because videogames can and do offer existing generations many opportunities to engage, and have fun. Furthermore, this framework lends itself greatly to the Generation X cohort and preceding generations, who are tech savvy and are more aware of age-related factors.

Recent statistics illustrate this entertainment medium is continuing to gain attraction from older adults, and encouraging intergenerational gaming with (grand) children (Kakulla 2020). Given the opportunities afforded to gamers, videogames can facilitate a myriad of social connections including intergenerational game playing, playing with strangers, playing with friends who are known offline, while also playing with friends/gamers who are known through various online communities/games and who game play regularly (Kakulla 2020). By socially connecting through videogames, there is the possibility to reduce loneliness and social isolation experienced by individuals, and who use technology and social media platforms (e.g. Facebook) to connect socially with friends and family members (Marston 2019). Furthermore, while intergenerational gaming can offer all gamers the opportunity to share their knowledge, experiences, and learn from each other; for many older gamers the ability to relieve anxiety or stress (57%), to have fun (76%), to be challenged/solve problems (63%), to stay mentally sharp (67%), to learn something new (33%), and to spend time with family (24%) (Kakulla 2020) demonstrates the growing preference for this leisure activity which in turn offers intergenerational engagement.

This scoping review focuses and reports specifically on videogames which recruited Generation X participants between 1970 and 2000. Results have identified 20 papers fitting the selection criteria, in conjunction with five primary themes and corresponding secondary themes. The work presented here impacts and intersects across multiple disciplines from the perspective of academe, industry and society. This scholarly work contributes to a growing body of work, and the authors believe this is the first review which focuses on Generation X and videogames. Several recommendations are proposed in a bid to further this work, and to prepare multiple actors of a change in shift, regarding future ageing cohorts/populations. The latter has garnered inadequate scholarly attention, yet, Generation X are going to be following the Baby Boomers into the position of next ageing population.

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Compliance with Ethical Standards

Conflict of interest The authors report no conflict of interest.

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References

Abt, C. (1987). *Serious games*. Lanham: University Press of America.

Adams, E. (2009). *Fundamentals of game design* (2nd ed.). Berkeley, CA: New Riders.

Baer, L. (1980). Effect of a time-slowing suggestion on performance accuracy on a perceptual motor task. *Perceptual and Motor Skills, 51,* 167–176. https://doi.org/10.2466/pms.1980.51.1.167.

Ballard, M., & Lineberger, R. (1999). Video game violence and confederate gender: Effects on reward and punishment given by college males. *Sex Roles, 41*(7), 541–558. https://doi.org/10.1023/A:1018843304606.

Ballard, M. E., & Wiest, J. R. (1996). Mortal Kombat (tm): The effects of violent videogame play on males' hostility and cardiovascular responding. *Journal of Applied Social Psychology, 26*(8), 717–730. https://doi.org/10.1111/j.1559-1816.1996.tb02740.x.

Barnett, D. (2017). In the war between millennials and baby boomers we have forgotten about the work-hard, play-hard Generation X. In *Independent*. Retrieved from https://www.independent.co.uk/life-style/health-and-families/millenials-generation-x-baby-boomers-a7570326.html.

Barnett, M. A., Vitaglione, G. D., Harper, K. K. G., Quackenbush, S. W., Steadman, L. A., & Valdez, B. S. (1997). Late adolescents' experiences with and attitudes toward videogames. *Journal of Applied Social Psychology, 27*(15), 1316–1334. https://doi.org/10.1111/j.1559-1816.1997.tb01808.x.

Bogost, I. (2007). *Persuasive games*. Cambridge, MA: MIT Press.

Braun, C. M. J., & Giroux, J. (1989). Arcade video games: Proxemic, cognitive and content analyses. *Journal of Leisure Research, 21*(2), 92–105. https://doi.org/10.1080/00222216.1989.11969792.

Brown, M., Hall, L. R., Holtzer, R., Brown, S., & Brown, N. (1997). Gender and video game performance. *Sex Roles, 36*(11), 793–812. https://doi.org/10.1023/A:1025631307585.

Brown, J. A., & De Schutter, B. (2016). Game design for older adults: Lessons from a life course perspective. *International Journal of Gaming and Computer-Mediated Simulations (IJGCMS), 8*(1), 1–12. https://doi.org/10.4018/IJGCMS.2016010101.

Brown, J. A., & Marston, H. R. (2018). Gen X and digital games: looking back to look forward. In J. Zhou & G. Salvendy (Eds.), *Human Aspects of IT for the Aged Population. Applications in Health, Assistance, and Entertainment. ITAP 2018. Lecture Notes in Computer Science* (Vol. 10927, pp. 1–14). Springer, Cham. https://doi.org/10.1007/978-3-319-92037-5_34.

Bryce, J., & Rutter, J. (2002). Killing like a girl: gendered gaming and girl gamer's visibility. Presented at Computer Games and Digital Cultures. Finland: Tampere.

Bryce, J., & Rutter, J. (2003). The gendering of computer gaming: Experience and space. *Leisure Cultures Investigations in Sport, Media and Technology, 79*(22), 3–22. https://doi.org/10.1080/02614360320000048966.

Buss, A. H., & Durkee, A. (1957). An inventory for assessing different kinds of hostility. *Journal of Consulting Psychology, 21*, 343–349.

Calvert, S. L., & Tan, S. L. (1994). Impact of virtual reality on young adults' physiological arousal and aggressive thoughts: Interaction versus observation. *Journal of Applied Developmental Psychology, 15*(1), 125–139. https://doi.org/10.1016/0193-3973(94)90009-4.

Cassell, J., & Jenkins, H. (Eds.) (2000). *From Barbie® to mortal kombat gender and computer games* (1st ed.). Cambridge, MA: MIT Press.

Charmaz, K. (2013). *Constructing grounded theory*. Thousand Oaks: SAGE Publications Inc.

Dalziel, F. R., Metzer, J. C., & Waters, L. K. (1989). Behavioural correlates of extrinsically reinforced video game play. *Behavioural Processes, 18*(1), 17–34. https://doi.org/10.1016/S0376-6357(89)80003-8.

De la Hera, T., Loos, E., Simons, M., & Blom, J. (2017). Benefits and factors influencing the design of intergenerational digital games: A systematic literature review. *Societies, 7*(3), 18. https://doi.org/10.3390/soc7030018.

De Schutter, B. (2011). Never too old to play: The appeal of digital games to an older audience. *Games and Culture, 6*(2), 155–170. https://doi.org/10.1177/1555412010364978.

De Schutter, B., & Brown, J. A. (2015) Digital games as a source of enjoyment in later life. *Games and Culture, 11*(1–2):28–52.

De Schutter, B., Roberts, A. R., & Franks, K. (2017). Miami six-O: Lessons learned from an intergenerational game design workshop. In M. Romero, K. Sawchuk, J. Blat, S. Sayago, & H. Ouellet (Eds.), *Game-based learning across the lifespan Advances in game-based learning* (pp. 13–27). Cham: Springer. https://doi.org/10.1007/978-3-319-41797-4.

De Schutter, B., & Vanden Abeele, V. (2010). Designing meaningful play within the psycho-social context of older adults. In *Proceedings of the 3rd international conference on fun and games—Fun and games'10* (pp. 84–93). https://doi.org/10.1145/1823818.1823827.

Diaz-Orueta, U., Facal, D., Nap, H. H., & Ranga, M.-M. (2012). What is the key for older people to show interest in playing digital learning games? Initial qualitative findings from the LEAGE Project on a multicultural European sample. *Games for Health Journal, 1*(2), 115–123. https://doi.org/10.1089/g4h.2011.0024.

Economic and Social Research Council. (2016). https://esrc.ukri.org/news-events-and-publications/news/news-items/thatcher-s-children-the-lives-of-generation-x/. Retrieved 28 January 2019, from https://esrc.ukri.org/news-events-and-publications/news/news-items/thatcher-s-children-the-lives-of-generation-x/.

Ermi, L., & Mäyrä, F. (2005). Fundamental Components of the Gameplay experience: Analysing immersion. *Changing Views: Worlds in Play*. https://doi.org/10.1080/10641260490479818.

Fencott, C., Clay, J., Lockyer, M., & Massey, P. (2012). *Game invaders: The theory and understanding of computer games* (1st ed.). New York: Wiley.

Forster, W. (2005). *The Encyclopedia of game machines—Consoles, handheld and home computers 1972–2005*. Boca Raton: Game Plan.

Funk, J. B., Buchman, D. D., & Germann, J. N. (2000). Preference for violent electronic games, self-concept, and gender differences in young children. *American Journal of Orthopsychiatry, 70*(2), 233–241. https://doi.org/10.1037/h0087738.

Funk, J. B., Flores, G., Buchman, D. D., & Germann, J. N. (1999). Rating electronic games violen. *Youth and Society, 30*(3), 283–312. https://doi.org/10.1177/0044118X99030003002.

Gajadhar, B. J., Nap, H. H., De Kort, Y. A. W., Ijsselsteijn, W. A., Gajadhar, B. J., Nap, H. H., et al. (2010). Out of sight, out of mind: Co-player effects on Seniors' player experience. *Proceedings of the Fun and Games Conference*. https://doi.org/10.1145/1823818.1823826.

Harley, D., Fitzpatrick, G., & Axelrod, L. (2010). HCI in Work and Learning. *Life and Leisure*. https://doi.org/10.1007/978-3-642-16607-5.

Hartmann, T., & Klimmt, C. (2006). Gender and computer games: Exploring females' dislikes. *Journal of Computer-Mediated Communication, 11*(4), 910–931. https://doi.org/10.1111/j.1083-6101.2006.00301.x.

Hayes, E. (2007). Gendered identities at play: Case studies of two women playing morrowind. *Games and Culture, 2*(1), 23–48. https://doi.org/10.1177/1555412006294768.
Herman, L. (2001). *Phoenix: The fall and rise of videogames*. Springfield: Rolenta Press.
Howe, N. (1993). *13th generation abort, retry, ignore, fail?* (1st ed.). New York: Vintage Books.
Howe, Neil, & Strauss, W. (1992). *Generations: The History of America's Future, 1584 to 2069* (Reprint ed.). Erin, ON: Quill.
Ijsselsteijn, W., Nap, H. H. H. H., De Kort, Y., & Poels, K. (2007). Digital game design for elderly users. In *Proceedings of the 2007 conference on future play, future play'07* (pp. 17–22). https://doi.org/10.1145/1328202.1328206.
Institute, M. M. M. (2013). *The MetLife study of gen X: The MTV generation moves into mid-life*. *MetLife mature market institute*. Retrieved from https://web.archive.org/web/20161021014452/, https://www.metlife.com/assets/cao/mmi/publications/studies/2013/mmi-gen-x.pdf.
Jansz, J., & Martis, R. G. (2007). The lara phenomenon: Powerful female characters in video games. *Sex Roles*. https://doi.org/10.1007/s11199-006-9158-0.
Jenson, J., & De Castell, S. (2004). Fair play: Gender, digital gaming and educational disadvantage. In *Human Perspectives in the internet society: culture, psychology and gender, 4*(2003), Wessex Inst Technol; Univ Bergen; Univ Cadiz. Retrieved from www.witpress.com.
Jenson, J., de Castell, S., & Fisher, S. (2007). Girls playing games. In *Proceedings of the 2007 conference on future play—future play'07* (vol. 9). https://doi.org/10.1145/1328202.1328205.
Nelson-Kakulla, B. (2020). *Gaming Trends of the 50+*. Washington, DC: AARP Research. https://doi.org/10.26419/res.00328.001.
Kasteleijn-Nolst Trenite, D. G. A., da Silva, A. M., Ricci, S., Binnie, C. D., Rubboli, G., Tassinari, C. A., et al. (1999). Video-game epilepsy: A European study. *Epilepsia, 40*(4), 70–74. https://doi.org/10.1111/j.1528-1157.1999.tb00910.x.
Kent, S. L. (2000). *The first quarter: A 25-year history of video games*. Pitampura: BWD Press.
King, A. E., & Douai, A. (2014). From the "Damsel in Distress" to Girls' games and beyond. *Gender considerations and influence in the digital media and gaming industry*. https://doi.org/10.4018/978-1-4666-6142-4.ch001.
Lawton, C. A., & Morrin, K. A. (1999). Gender differences in pointing accuracy in computer-simulated 3D mazes. *Sex Roles, 40*(1–2), 73–92. https://doi.org/10.1023/A:1018830401088.
Lindley, C. (2003). Game taxonomies: A high level framework for game analysis and design. Retrieved 3 February 2019, from https://www.gamasutra.com/view/feature/131205/game_taxonomies_a_high_level_.php.
Marston, H. R. (2012). *Older adults as 21st century game designers* (pp. 90–102). Whitsun: The Computer Games Journal.
Marston, H. R. (2013a). Digital gaming perspectives of older adults: Content vs. Interaction. *Educational Gerontology, 39*(3), 194–208. https://doi.org/10.1080/03601277.2012.700817.
Marston, H. R. (2013b). Design recommendations for digital game design within an ageing society. *Educational Gerontology, 39*(2):103–118. https://doi.org/10.1080/03601277.2012.689936.
Marston, H. R. (2019). Millennials and ICT—Findings from the technology 4 young adults (T4YA) project: An exploratory study. *Societies, 9*(4), 80. https://doi.org/10.3390/soc9040080.
Marston, H., & Graner-Ray, S. (2016). Older women on the game: Understanding digital game perspectives from an ageing cohort. In E. Domínguez-Rué & L. Nierling (Eds.), *Ageing and technology: Perspectives from the social sciences* (pp. 67–92). Bielefeld: Transcript Verlag. https://doi.org/10.14361/9783839429570.
Marston, H. R., Kroll, M., Fink, D., & Gschwind, Y. J. (2016). Flow experience of older adults using the iStoppFalls exergame. *Games and Culture*. https://doi.org/10.1177/1555412015605219.
Marston, H. R., Kroll, M., Fink, D., Poveda, R., & Gschwind, Y. J. (2017). Digital game technology and older adults. In H. R. Marston, S. Freeman, & C. Musselwhite (Eds.), *Mobile e-Health* (pp. 149–171). Cham: Springer. https://doi.org/10.1007/978-3-319-60672-9_7.
Marston, H. R., & McClenaghan, P. A. (2013). Play yourself fit: Exercise + videogames = exergames. In K. Bredl & W. Bosche (Eds.), *Serious games and virtual worlds in education. Professional Development, and Healthcare*. Pennsylvania: IGI Global. https://doi.org/10.4018/978-1-4666-3673-6.ch015.
Marston, H. R., & van Hoof, J. (2019). Who doesn't think about technology when designing urban environments for older people? A case study approach to a proposed extension of the WHO's age-friendly cities model. *International Journal of Environmental Research and Public Health*. https://doi.org/10.3390/ijerph16193525.

Miller, S., & Ditto, B. (1988). Cardiovascular responses to an extended aversive video game task. *Psychophysiology, 25*(2), 200–206. https://doi.org/10.1111/j.1469-8986.1988.tb00988.x.

Millett, C. J., Fish, D. R., Thompson, P. J., & Johnson, A. (1999). Seizures during video-game play and other common Leisure pursuits in known epilepsy patients without visual sensitivity. *Epilepsia, 40*(s4), 59–64. https://doi.org/10.1111/j.1528-1157.1999.tb00908.x.

Mueller, F., Edge, D., Vetere, F., Gibbs, M. R., Agamanolis, S., Bongers, B., & Sheridan, J. G. (2011). Designing sports: A framework for exertion games. In *Proceedings of the 2011 annual conference on human factors in computing systems—CHI'11* (pp. 2651–2660). https://doi.org/10.1145/1978942.1979330.

Mueller, F., Gibbs, M., & Vetere, F. (2008). Taxonomy of exertion games. In *Proceedings of the 20th Australasian computer–human interaction conference, OZCHI 2008* (pp. 263–266). New York, NY: ACM. https://doi.org/10.1145/1517744.1517772.

Nacke, L. E., & Lindley, C. A. (2008a). Flow and immersion in first-person shooters: measuring the player's Gameplay experience. In *Proceedings of the 2008 conference on future play: Research, play, share* (pp. 81–88). https://doi.org/10.1145/1496984.1496998.

Nacke, L. E., & Lindley, C. A. (2010). Affective ludology, flow and immersion in a first-person shooter: Measurement of player experience. https://doi.org/10.1145/1496984.1496998.

Nacke, L., & Lindley, C. (2008b). Boredom, immersion, flow—A pilot study investigating player experience. *Measurement, 24,* 1–5. https://doi.org/10.1073/pnas.1007983107.

Nap, H. H., De Kort, Y. A. W., & Ijsselsteijn, W. A. (2009a). Senior gamers: Preferences, motivations and needs. *Gerontechnology, 8*(4), 247–262. https://doi.org/10.4017/gt.2009.08.04.003.00.

Nap, H. H. H., Ijsselsteijn, W. A. W., De Kort, Y. A. W. (2009b). Age differences in associations with digital gaming. In *Breaking new ground: Innovation in games, play, practice and theory. Proceedings of DiGRA 2009*. Retrieved from http://www.digra.org/dl/db/09287.31341.pdf.

Neale, S. (1980). *Genre*. London: BFI Publishing.

Nielsen. (2014). *Millennials: Breaking the Millennials*. New York: Nielsen Company.

O'Connor, T. J., Cooper, R. A., Fitzgerald, S. G., Dvorznak, M. J., Boninger, M. L., Van Sickle, D. P., et al. (2000). Evaluation of a manual wheelchair interface to computer games. *Neurorehabilitation and Neural Repair, 14*(1), 21–31. https://doi.org/10.1177/154596830001400103.

Oh, Y., & Yang, S. (2010). Defining exergames and exergaming. In *Meaningful play 2010* (pp. 1–16). Retrieved from http://meaningfulplay.msu.edu/proceedings2010/mp2010_paper_63.pdf.

Orland, K., &, & Remo, C. (2008). Games for health: Noah Falstein on exergaming history. In *Gamasutra* (pp. 1–2). Retrieved from https://www.gamasutra.com/view/news/109512/Games_For_Health_Noah_Falstein_On_Exergaming_History.php.

Pearce, C. (2008). The truth about baby boomer gamers: A study of over-forty computer game players. *Games and Culture, 3*(2), 142–174. https://doi.org/10.1177/1555412008314132.

Pepin, M., & Dorval, M. (1986). Effect of playing a video game on adults' and adolescents' spatial visualization. *Educational Technology, 26*(10), 48–52.

Philippatos, G. C., & Moscato, D. R. (1971). Effects of constrained information on player decisions in experimental business simulation: Some empirical evidence. *Journal of ACM, 18*(1), 94–104. https://doi.org/10.1145/321623.321633.

Strauss, W., & Howe, N. (1997). *The fourth turning: An American prophecy*. Bantam: 1st Trade Pbk. Ed.

Taylor, P., & Gao, G. (2014). Generation X: America's neglected 'middle child'. Retrieved 2 December 2018, from http://www.pewresearch.org/fact-tank/2014/06/05/generation-x-americas-neglected-middle-child/.

Temple, L., & Lips, H. M. (1989). Gender differences and similarities in attitudes toward computers. *Computers in Human Behavior, 5*(4), 215–226. https://doi.org/10.1016/0747-5632(89)90001-0.

Tkacz, S., & Laforce, P. (1998). Sex of player and practice in lateral discrimination and videogame performance. *Perceptual and Motor Skills, 87*(3 suppl), 1395–1404. https://doi.org/10.2466/pms.1998.87.3f.1395.

Tricco, A. C., Lillie, E., Zarin, W., O'Brien, K. K., Colquhoun, H., Levac, D., et al. (2018). PRISMA extension for scoping reviews (PRISMA-ScR): Checklist and explanation. *Annals of Internal Medicine, 169*(7), 467–473. https://doi.org/10.7326/M18-0850.

Turner, J. R., Treiber, F. A., Davis, H., Rectanwald, J., Pipkin, W., & Strong, W. B. (1997). Use of a virtual reality car-driving Stressor in cardiovascular reactivity research. *Behavior Research Methods, Instruments, and Computers, 29*(3), 386–389. https://doi.org/10.3758/BF03200591.

Vogels, E. (2019). Millennials stand out for their technology use, but older generations also embrace digital life. Retrieved from 12 December 2019, https://www.pewresearch.org/fact-tank/2019/09/09/us-generations-technology-use/.

Voida, A., & Greenberg, S. (2009). Wii all play: The console game as a computational meeting place. In *Proceedings of the 27th international conference on human factors in computing systems—CHI'09* (pp. 1559–1568). https://doi.org/10.1145/1518701.1518940.

Voida, A., & Greenberg, S. (2010). *A gameroom of our own: Exploring the domestic gaming environment*. Alberta: Calgary.

Voida, A., & Greenberg, S. (2012). Console gaming across generations: Exploring intergenerational interactions in collocated console gaming. *Universal Access in the Information Society, 11*(1), 45–56. https://doi.org/10.1007/s10209-011-0232-1.

Wang, B., Taylor, L., & Sun, Q. (2018). Families that play together stay together: Investigating family bonding through video games. *New Media and Society, 20*(11), 4074–4094. https://doi.org/10.1177/1461444818767667.

White, G., Harley, D., Axelrod, L., McAllister, G., & Fitzpatrick, G. (2009). Wii gaming for older players: From motivation to appropriation, and usability to user experience. In *Breaking new ground: Innovation in games, play, practice and theory: Proceedings of the 2009 digital games research association conference* (pp. 1–3).

WHO. (2007). *Global age-friendly cities : A guide*. Retrieved from www.who.int/ageing/enFax:+41.

Wilder, G., Mackie, D., & Cooper, J. (1985). Gender and computers: Two surveys of computer-related attitudes. *Sex Roles*. https://doi.org/10.1007/BF00287912.

Wilson, S. C., & Barber, T. X. (1976). The Creative Imagination Scale: Applications to clinical and experimental hypnosis. Unpublished manuscript, Medfield, Massachusetts: Medfield Foundation.

Zickuhr, K. (2010). Generations 2010. *Pew Internet and American Life Project*. https://doi.org/10.1177/1461444800002004001.